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EFFECT OF DIFFERENT ORGANIC EXTRACTS ON GRAIN YIELD AND SOME PHYSIOLOGICAL TRAITS OF THREE BREAD WHEAT CULTIVARS

Sura Jasim Bunder¹Sura.j@coagri.uobaghdad.edu.iq

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ABSTRACT

An experiment was conducted in the Abu Ghraib area, located in the western part of Baghdad, during the 2023-2024 season to determine the effect of various organic extracts (Moringa leaves, licorice root, yeast, and water) on grain yield and some physiological traits of three wheat cultivars (IPA-99, Al-tahadi, and Al-fatih). The experiment was laid out in a Randomized Complete Blocks Design (RCBD) within a split-plot arrangement, cultivars distributed in main plots, and organic extracts in subplots with three replications.

Cultivar IPA-99 was superior in grain yield (4.483 t.ha⁻¹) and most of the studied characteristics (flag leaf area 45.88 cm², dry weight of flag leaf 0.180g, number of tillers 505.4m⁻², number of spikes 421.6 spike m⁻², dry weight of spike⁻¹ 1.205 g, number of grains per spike 54.03 grain spike⁻¹, and weight 1000 grain 41.21g). Moringa leaves extract gave the highest grain yield (4.181 t ha⁻¹) and most of the characteristics (leaf area 45.87cm², dry weight of flag leaf 0.175g, number of tillers 489.8m⁻², number of spikes 420.5 spike.m⁻², dry weight of spike⁻¹ 1.196g, and number of grains per spike 52.18 grain spike⁻¹). The effect of interaction was significant in most studied traits. It can be concluded that organic extracts are safe and environmentally friendly bio stimulants that increase productivity, especially Moringa leaf extract, which gave the highest increase in grain yield. Furthermore, the IPA-99 cultivar was significantly superior to the other cultivars in the most studied characters.

Keywords: Bio stimulants, soaking, leaf area, dry weight of spike.

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is one of the most important cereal crops that plays a vital role in human nutrition. The wheat grain contains 60-70% carbohydrates, 8-15% proteins, and various nutrients such as vitamins, minerals, and fiber [5]. Seed soaking is a simple, inexpensive technique that occurs before planting. It stimulates the metabolic processes necessary for germination, improving plant growth and

¹ College of Agriculture Engineering Science, University of Baghdad, Baghdad, Iraq

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development through rapid and regular germination, increased tillers, early flowering, and higher grain yield [8]. In the last years, the world has focused its attention on reducing the use of agricultural chemicals, which pose a threat to food security and the ecosystem in the long term, this is a result of the many problems that have arisen when using them, such as soil hardening, decreased fertility, and the impact on the composition of the soil microbiome, which exposes plants to diseases, in addition to its high cost [19]. Therefore, many specialists in the agricultural field have resorted to finding alternatives made from organic materials that are environmentally safe, cheap, and easy to prepare, and lead to increasing plant productivity [16, 28].

Plant extracts are known as biostimulants and which are natural substance such as Moringa leaves are the most widely used part of the plant and are rich in the natural plant hormone zeatin which belongs to the group of cytokinins and increases grain yield between 10-45% as well as other phytohormones such as indol-3-acetic acid (IAA), gibberellins (GAs), the leaves also contain proteins, vitamins E and C, phenols, amino acids, various mineral elements and some plant secondary metabolites [9]. The licorice plant is known to contain many chemical compounds whose effect is similar to steroid hormones (building hormones), which lead to increased protein formation and thus increased growth rate. Licorice root, the most widely used part of the plant, contains compounds similar to the effect of growth regulators and a wide range of minerals, amino acids, vitamins, and carbohydrates in addition to mevalonic acid, which has a role in the biosynthesis of gibberellin [1].

Bread yeast is a rich source of plant hormones, particularly cytokinins. It also contains vitamins, enzymes, minerals, and compounds that produce semi-growth regulators, such as auxin and gibberellin. These compounds affect the synthesis of protein and amino acids, as well as the formation of chlorophyll [21, 27]. Ali *et al.* [3] found that yeast extract encourages growth and productivity for two cultivars of bread wheat. Bunder [6, 7] found that soaking seeds of three wheat cultivars with Moringa leaves extract resulted in a significant increase in flag leaf area, yield components, and grain yield. The results also showed that the cultivars differed significantly in most of the studied traits. Al-Baldawi *et al.* [2] reported that the positive effect of soaking seeds of bread wheat cultivars with extracts such as licorice root on grain yield and its components, and the IPA-99 cultivar was superior in most of the studies' traits. Saudi [20] found that the genotype IPA-99 was superior to the other genotypes (Buhooth22, Al-tahadi, IPA-99, and Rasheed) in flag leaf area, number of tillers, number of spikes, 1000 grain weight, and grain yield in both study seasons. Therefore, this experiment aims to study the effect of different organic extracts on grain yield and some physiological traits for three varieties of bread wheat.

MATERIAL AND METHOD

A field experiment was conducted in the Abu Ghraib area, located in the western part of Baghdad, during 2023-2024 winter season to determine the effect different organic extracts in grain yield some physiological traits of three bread wheat cultivars. The experiment was laid out in Randomized Complete Block Design (RCBD) with split plot arrangement, placing cultivars in main plots and organic extracts in subplots with three replications. The experiment included three bread wheat varieties (IPA-99, Al-tahadi and Al-fatih) and organic extracts (Moringa leaves, licorice root, Yeast, and water as control). The area of each experimental plot was 4 m² and consisted of 8 rows of 2 m length and spaced 20 cm apart, wheat seeds were sown in 20th November with seed rate of 120 kg.ha⁻¹. Before planting, the

experimental soil was analyzed to determine its properties and showed that the soil was a sand mixture in texture with 34.00 ppm available nitrogen, 10.18 ppm available phosphorus and 162.00 ppm available potassium, 2.57 dSm⁻¹ Ec and 7.51 pH. Recommended of nitrogen 260 kg.ha⁻¹ was applied in a form of urea (46%N) in two split doses 120 kg ha⁻¹ at tillering stage ZGS:20 and 140 kg.ha⁻¹ at booting stage ZGS:40 according to Zadoks scale [29], while the NPK fertilizer 15:15:15 full dose 500 kg.ha⁻¹ were added during land preparation [11].

Preparation of organic extracts

Take 100g of Moringa leaves powder, add 500 ml of distilled water at a temperature of 40 °C and left for 24h at room temperature than was filtered with filter paper [10]. Take 100g of licorice root powder, add 200 ml of distilled water at 50°C, then put the mixture in an dark bottle and left for 24h, then it was filtered with filter paper [24]. Dissolved 1g from dry baking yeast (*Saccharomyces cerevisiae*) in a little distilled water at a temperature of 35°C followed adding sugar 0.5g left the solution in a warm place for 12h for the yeast cells to grow and multiply then completed with distilled water to 1 liter [15]. A concentration of 3% was used for all extracts, the seeds of wheat cultivars were soaked with the extracts and distilled water for 10h. Studied characters:

Flag leaf area (cm²): at the anthesis, calculated from the average of ten flag leaf for main stems per plot, according to the formulae of Thomas [23]. Leaf length × width at the middle ×0.95

Dry weight of flag leaf (g): flag leaves were dried in an electric oven at 70°C, then the weight was an electric balance and the average was recorded.

Dry weight of spike (g): ten spikes for main stems per plot were dried in an oven at 70°C, then the weight were an electric balance and the average was recorded.

Number of tillers (m⁻²): an area of 0.30m² in each plot was selected, record the number of tillers was recorded, then converted to square meters.

Number of spikes (m⁻²): it was counted from square meter area at the harvest.

Number of grains spike⁻¹: the average number of grains of ten randomly spikes per plot was recorded.

1000grain weight (g): 1000 grains of each plot were counted then weighted by digital balance.

Grain yield (t ha⁻¹): estimated from meter square area at 12% moisture content then converted into t ha⁻¹. (L.S.D) used at the level of 0.05 to compare among the treatment means studied traits (22).

Table 1: Information about the cultivars used in the experiment

Cultivars	Origin	Breeding method	Derivation body
IPA-99	Iraq	Selection from isolated generations	IPA Center for Agricultural Research
Al-tahadi	Iraq	Hybridization	Seed Technology Center
Al-fatih	Iraq	Hybridization	Department of Agricultural Research / Ministry of Agriculture

RESULTS AND DISCUSSION

Flag leaf area (cm²)

Results in Table 2 showed significant difference among genotypes for leaf area. Highest flag leaf area were recorded with IPA-99 plants (45.88cm²), followed by Al-tahadi plants (40.69cm²) than Al-fatih (37.92 cm²). This finding might be

attributed to the genetic variation between these cultivars and the nature of their growth. Wheat plants soaked seeds with Moringa leaves extract showed significant increase in this trait (45.87 cm^2), whereas plants control treatment recorded lowest means (38.69 cm^2), which did not differ significantly from yeast extract, which gave (38.91 cm^2). This may be attributed to the Moringa leaves extract containing nutrients and various growth regulators, especially (cytokinin and auxin) its known role to improve cell metabolic processes as well as increase cell division and elongation [4, 9]. As shown in Table 2 the interaction between cultivar IPA-99 with extract of Moringa were recorded the highest mean (51.15 cm^2) in comparison with cultivar Al-fatih and water which recorded lowest mean (35.92 cm^2) in flag leaf area.

Table 2: Effect of cultivars, organic extracts in leaf area (cm^2)

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	51.15	44.70	41.75	45.87
LRE	46.92	42.95	39.69	43.19
YE	43.40	37.00	36.33	38.91
H ₂ O	42.05	38.11	35.92	38.69
L.S.D	2.49			1.23
Mean	45.88	40.69	37.92	
L.S.D	1.56			

Dry weight of flag leaf (g)

The effect of wheat cultivars, organic extracts and their interactive were found significant in dry weight of flag leaf (g). Highest dry weight were recorded with IPA-99 plants (0.180g), followed by Al-tahadi (0.151g) whereas lowest dry weight of the same trails were recorded from plants of Al-fatih (0.139g). These results might be attributed to the area of the flag leaf (Table 2.). Highest mean was obtained Moringa extract during season (0.175g), while the lowest values were noticed with control treatment (0.139g). The important role of nutrients in the extracts in most of the vital activities within the plant that are related to the processes of growth, division, increasing the efficiency of light interception and the ability to convert it into chemical energy [17]. As shown in Table 3. The interaction between IPA-99 plants and Moringa extract recorded highest values (0.202g) in comparison Al-fatih with water which recorded lowest values (0.126g).

Table 3: Effect of cultivars, organic extracts in dry weight of leaf area (g)

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	0.202	0.168	0.154	0.175
LRE	0.187	0.161	0.147	0.165
YE	0.170	0.142	0.130	0.147
H ₂ O	0.159	0.132	0.126	0.139
L.S.D	0.010			0.004
Mean	0.180	0.151	0.139	
L.S.D	0.007			

Number of tillers (m^{-2})

Table 4 showed that there are significant differences between the cultivars, organic extracts and the interaction on number of tillers. IPA-99 c.v. gave the highest number of tillers (505.4m^{-2}), followed by Al-tahadi (440.2m^{-2}) than Al-fatih (409.9m^{-2}). These differences between cultivars are due branching is one of the characteristics associated with the genetic makeup [25]. Moringa extract gave the highest values of number tillers (489.8m^{-2}) compared to control treatment which gave lowest values (418.0m^{-2}). The reason behind the highest number of tillers could be due to extracts improves nutrients absorption efficiency [12]. Agree with the results Khan *et al.* [14] and Rehman *et al.* [18]. The interaction of IPA-99 cultivar with Moringa gave the highest number of tillers (544.3m^{-2}), while the lowest number was Al-fatih with plants water (385.4m^{-2}).

Table 4: Effect of cultivars, organic extracts in number of tillers (m^{-2})

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	544.3	481.1	443.9	489.8
LRE	519.9	462.5	422.1	468.2
YE	488.6	417.3	388.3	431.4
H ₂ O	468.7	399.9	385.4	418.0
L.S.D	19.2			10.0
Mean	505.4	440.2	409.9	
L.S.D	15.4			

Number of spikes (m^{-2})

The number of spikes is an essential component of the wheat grain yield and is determined in the early stages of the plant's life during the branch formation stage. Results in Table 5 indicated that effect of cultivars, organic extracts and their interaction had a significant effect on number of spikes. Regarding cultivars, IPA-99 had the highest number of spikes ($421.6\text{ spike m}^{-2}$) followed Al-tahadi ($371.1\text{ spike m}^{-2}$), while the lowest number of spikes ($334.6\text{ spike m}^{-2}$) was produced with Al-fatih. These results might be due to that IPA-99 plants produced more number of tillers (Table 4.). All extracts increased the number of spikes per unit area compared to control, highest number of spikes ($420.5\text{ spike m}^{-2}$) were recorded at Moringa leaves extract, while the lowest number of spikes ($331.7\text{ spike m}^{-2}$) were produced at water. This might be due to higher leaf area (Table 2.) is an indicator of the efficiency photosynthesis and carbohydrate production which reduced competition between tillers and produced most of them for spikes and increased their number per unit area. Agree with the result Rehman *et al.* [18]. Results presented in Table 5 indicated that the studied interaction cultivars and organic extracts had a significant effect on number of spikes. Generally, the highest number of spikes was given by IPA-99 with Moringa leaves extract ($473.9\text{ spike m}^{-2}$), whereas the lowest number of spikes was produced by Al-fatih with water ($304.2\text{ spike m}^{-2}$).

Table 5: Effect of cultivars, organic extracts in number of spikes (m^{-2})

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	473.9	409.1	378.6	420.5
LRE	442.9	393.5	350.8	395.7
YE	416.1	355.9	325.5	365.8
H ₂ O	369.5	321.4	304.2	331.7
L.S.D	16.1			8.8
Mean	421.6	371.1	334.6	
L.S.D	13.2			

Dry weight of spike (g)

Highest dry weight of spike was recorded with IPA-99 plants (1.205g) followed by Al-tahadi plants (1.124g), whereas lowest dry weight of the same trait were recorded from plants of Al-fatih (1.065g), respectively. The variation in dry weight of spike among cultivars might be attributed to increase the area of the flag leaf (Table 2), its dry weight (Table 3) and important role in providing the spike with the products of photosynthesis. Organic extracts had a significant effect on the dry weight of spike highest dry weight of spike (1.196g) was recorded Moringa leaves extract, while the lowest dry weight of spike (1.060g) were produced at control (water). Moringa extract plays an important role in increases the stimulation of photosynthesis (14) which increases the accumulation of dry matter responsible for growth and development of the florets. Interaction of cultivars $\times$ organic extracts was significant, cultivar IPA-99 gave highest dry weight of spike (1.326g) at Moringa leaves extract, whereas the lowest dry weight of the same trait were obtained from Al-fatih plants at water (1.009g).

Table 6: Effect of cultivars, organic extracts in dry weight of spike (g)

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	1.326	1.161	1.100	1.196
LRE	1.238	1.150	1.083	1.157
YE	1.187	1.136	1.079	1.134
H ₂ O	1.106	1.065	1.009	1.060
L.S.D	0.036			0.024
Mean	1.205	1.124	1.065	
L.S.D	0.028			

Number of grains.spike⁻¹

Wheat cultivars, organic extracts and their interaction significantly affected number of grains in spike⁻¹ (Table 7.). Regarding cultivars, IPA-99 produced highest number of grains spike⁻¹ (54.03 grains spike⁻¹), than Al-tahadi (46.84 grains.spike⁻¹), whereas Al-fatih gave the lowest number (43.11 grains.spike⁻¹). The differences between cultivars in the number of grains per spike due genetic nature. The same table also showed, Moringa leaves extract was gave the highest number of grains in spike⁻¹ (52.18 grain spike⁻¹) compared with water which gave the lowest number of grains in spike⁻¹ (42.86 grains.spike⁻¹). Moringa is rich in cytokinin, increased the duration of the leaves remaining green for the longest possible duration and improved photosynthesis, increased carbohydrates and their transfer from sources to sinks,

which led to reducing competition between grains and increasing their number. Results confirming these findings were demonstrated by Khan *et al.* [14] and Rehman *et al.* [18]. Interaction treatment of IPA-99 with Moringa leaves extract gave highest number of grains.spike⁻¹ (59.55 grains.spike⁻¹), while the lowest means of this trait were recorded with Al-fatih plants at water (38.70 grains.spike⁻¹).

Table 7: Effect of cultivars, organic extracts in number of grains.spike⁻¹

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	59.55	50.52	46.47	52.18
LRE	53.74	48.49	44.11	48.78
YE	55.12	46.19	43.15	48.15
H ₂ O	47.71	42.17	38.70	42.86
L.S.D	2.86			1.61
Mean	54.03	46.84	43.11	
L.S.D	2.00			

1000-grain weight (g)

Showed cultivars significant variation in 1000-grain weight (g) (Table 8.). IPA-99 had the heaviest 1000-grain weight (41.21g), followed by Al-tahadi (39.66g) and then Al-fatih (36.50g). This difference between varieties may be due to the grain filling period. Results of this study reveal that the 1000-grain weight of wheat was significantly influenced due to soaking organic extracts. The heaviest 1000-grain weight was recorded for yeast extract (40.00g), while the lightest value was Moringa leaves extract (37.65g). The reason for this may be attributed to increasing two components of the wheat grain yield (Table 5, 7) decreases the other component. Agree with the result Khan *et al.* [14]. The interaction of cultivars × organic extracts had significant effect on this trait. Cultivar IPA-99 plants produced heaviest 1000 grain (42.28g) at licorice root extract, whereas the cultivar Al-fatih produced the lightest 1000-grain (34.12g) at Moringa leaves extract.

Table 8: Effect of cultivars, organic extracts in 1000 grain weight (g)

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	40.06	38.78	34.12	37.65
LRE	42.28	40.33	36.25	39.62
YE	41.64	40.54	37.81	40.00
H ₂ O	40.86	39.00	37.82	39.23
L.S.D	1.72			1.00
Mean	41.21	39.66	36.50	
L.S.D	1.08			

Grain yield (t.ha⁻¹)

Grain yield is a complex characteristic resulting from the interaction of various plant characteristics. Table 9 showed that significant effect of cultivars in grains yield. The cultivar IPA-99 gave the highest yield (4.483 t.ha⁻¹) followed by Al-tahadi (3.906 t.ha⁻¹) and Al-fatih (3.420 t.ha⁻¹). These differences among the three wheat cultivars may be attributed to the varieties in genetic and physiological nature, which was reflected in the components of the yield. The results showed that Moringa leaves extract recorded the highest value for this trait (4.181 t.ha⁻¹), while the lowest value

was obtained at water (3.501 t.ha⁻¹). Moringa extract is superior to grain yield result of the produces a compound zeatin-o-glucose (GOS) resulting from the combination of zeatin with glucose which increases the vegetative growth and led to an increase in yield components and, as a result, an increase in grain yield [13]. Results confirming these findings were demonstrated by Khan *et al.*, [14], Rehman *et al.* [18] and Yasmeen *et al.* [26]. The effect of interaction between organic extracts and cultivars was significant (Table 9). IPA-99 produced the highest grain yield (4.837 t.ha⁻¹) at Moringa leaves extract, whereas cultivar Al-fatih gave the lowest yield (3.079 t.ha⁻¹) at water.

Table 9: Effect of cultivars, organic extracts in grain yield (t.ha⁻¹)

Organic extracts	Cultivars			Means
	IPA-99	Al-tahadi	Al-fatih	
MLE	4.837	4.124	3.581	4.181
LRE	4.660	4.016	3.521	4.066
YE	4.488	4.008	3.497	3.998
H ₂ O	3.946	3.477	3.079	3.501
L.S.D	0.138			0.075
Mean	4.483	3.906	3.420	
L.S.D	0.112			

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تأثير مستخلصات عضوية مختلفة في حاصل حبوب وبعض الصفات الفسيولوجية لثلاثة اصناف من حنطة الخبز

سرى جاسم بندر¹

Sura.j@coagri.uobaghdad.edu.iq

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الملخص

نفذت تجربة حقلية في منطقة ابي غريب الواقعة في الجزء الغربي من محافظة بغداد، خلال الموسم الشتوي 2023-2024 لدراسة تأثير مستخلصات عضوية مختلفة (اوراق المورينكا، جذر السوس، الخميرة والماء) في حاصل حبوب وبعض الصفات الفسيولوجية لثلاثة اصناف من حنطة الخبز (اباء-99، التحدي والفتح). نفذت التجربة على وفق تصميم القطاعات الكاملة المعشاة بترتيب الالواح المنشقة، وزعت الاصناف في الالواح الرئيسية والمستخلصات العضوية في الالواح الثانوية بثلاث مكررات.

تفوق الصنف اباء-99 في حاصل الحبوب (4.483 ط.هـ¹) واغلب الصفات المدروسة (مساحة ورقة العلم 45.88 سم²، الوزن الجاف لورقة العلم 0.180 غم، عدد الاشطاء 505.4 م⁻²، عدد السنابل 421.6 سنبله.م⁻²، الوزن الجاف للسنبله 1.205 غم، عدد الحبوب لكل سنبله 54.03 حبة بالسنبله¹ ووزن 1000 حبة 41.21 غم). اعطى مستخلص اوراق المورينكا اعلى حاصل حبوب (4.181 طن.هـ¹) وفي معظم الصفات (مساحة ورقة العلم 45.87 سم²، الوزن الجاف لورقة العلم 0.175 غم، عدد الاشطاء 489.8 م⁻²، عدد السنابل 420.5 سنبله.م⁻²، الوزن الجاف للسنبله 1.196 غم، عدد الحبوب لكل سنبله 52.18 حبة بالسنبله¹). تأثير التداخل لكلا العاملين كان معنوياً في معظم الصفات المدروسة. يمكن الاستنتاج ان المستخلصات العضوية تعد منشطات حيوية امنة وصديقة للبيئة وزادت من الانتاجية وخاصة مستخلص اوراق المورينكا الذي أعطى أعلى زيادة في حاصل الحبوب، وان الصنف اباء-99 قد تفوق معنوياً على الاصناف الاخرى في معظم الصفات المدروسة.

الكلمات الدالة: المنشطات الحيوية، تنقيع، ورقة العلم، وزن السنبله الجاف

¹ جامعة بغداد، كلية علوم الهندسة الزراعية، بغداد، العراق.

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